Characteristics of Laminates with Magnetic Properties for Motor Slot Wedges and Other Applications at Cryogenic Temperatures

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ABSTRACT

This study presents data on a laminate which consists of an E-type glass fiber and Fe within an epoxy matrix. Our goal was to examine a composite with improved mechanical properties, especially fracture strength. We conducted investigations to determine the magnetic saturation of the laminate at different temperatures, as well as the core losses across a frequency range of 20 Hz to 120 Hz at 77 K.

INTRODUCTION

Magnetic materials, such as Soft Magnetic Composites (SMC), have significant applications in industries like electrical, computer, and telecommunications [1]. Recent advancements in powder composites have made SMC materials attractive for electrical machine applications, along with new design principles and manufacturing techniques. Researchers have studied the processing, additive effects, and applications of these materials [1,2,3].

Figure 1. : An example photo of Soft Magnetic Composites (SMC).

EXPERIMENTAL

The material consists of glass-fiber reinforcement, epoxy resin, and ≅70% Fe powder.

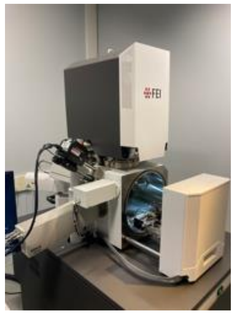

Figure 2: SEM Instrument at CEMAS

- Magnetic testing involved measuring hysteresis loops using a VSM at different temperatures
- Core losses were measured in a Spinning magnet calorimeter, as described in Ref [4].
- SEM observations utilized an electron microscope with SE and BSE detectors and EDS for elemental analysis.

RESULT

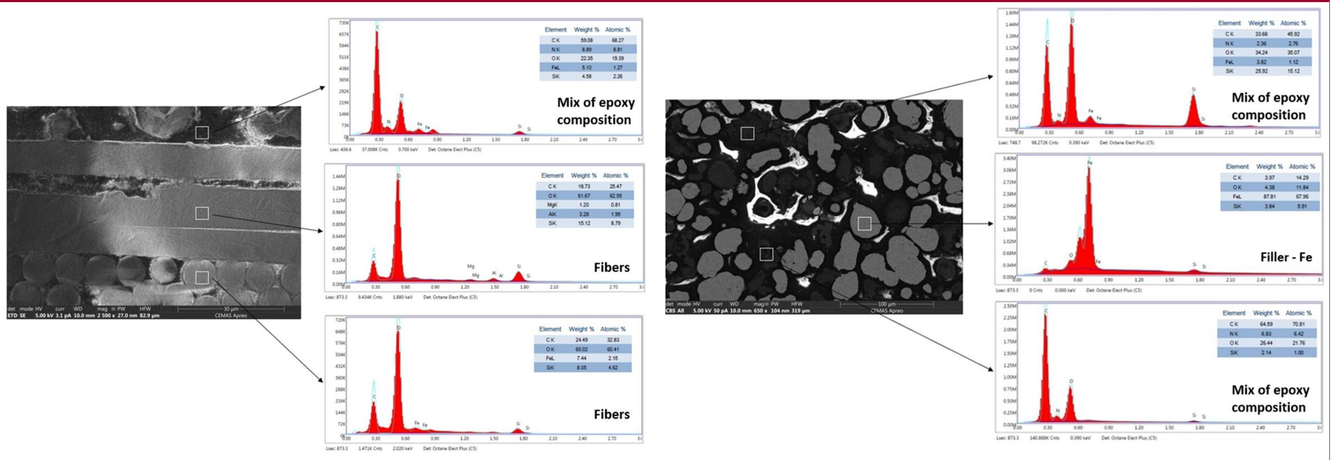

Figure 3. Examples of SEM image : a) ETD detector b) CBS detector

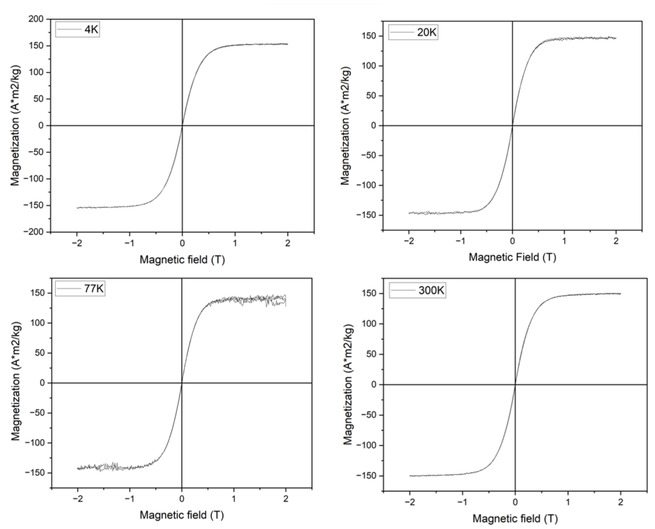

Figure 4. Magnetic hysteresis loops at 4K, 20K, 77K and 300K obtained for the magnetic epoxy glass laminate

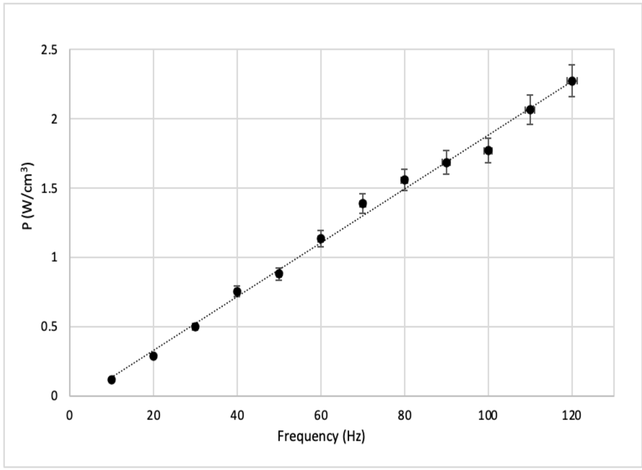

Figure 4. Core loss of magnetic epoxy glass laminate

CONCLUSION

- Temperature had minimal effect on magnetic saturation of the material.
- The next step in the study is to replace the iron powder with magnetite powder and compare their mechanical and magnetic properties in different environmental conditions.

Acknowledgement

This research has been made possible by the Kosciuszko Foundation. The American Centre of Polish Culture. The research results are part of a doctoral project in cooperation with the Polish company IZOERG.

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